Name _____

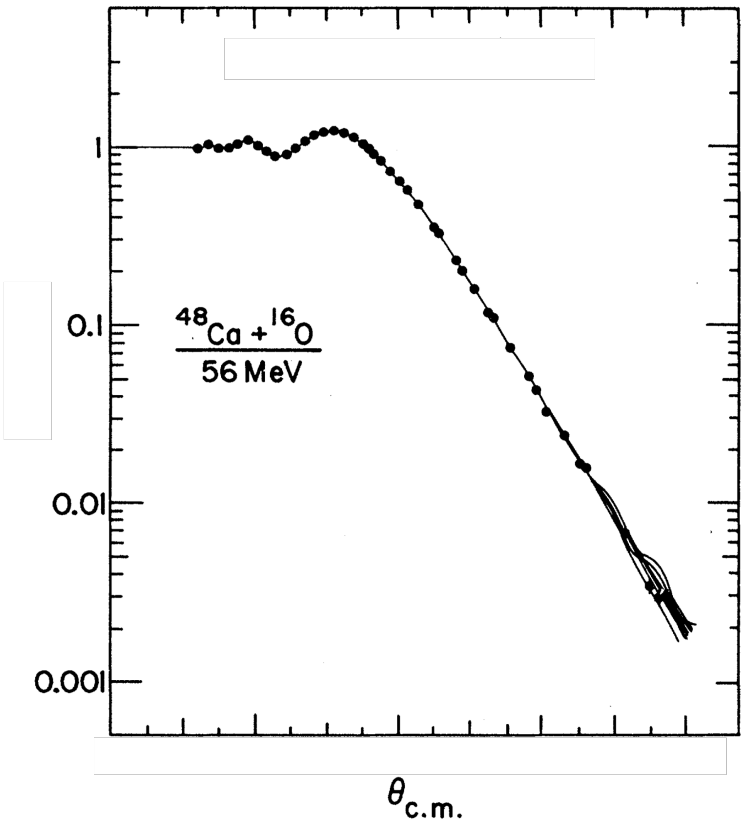
Exam Advanced Nuclear Physics 22/01/2018 9:00

Question: Nuclear Reactions

These questions will be evaluated on 20 points. You require a minimum of 7/20 points on this part to pass the course. The points will be rescaled to a weight of 6 towards your final grade for the course. You are not allowed any book or notes. You may use a calculator and the given list of formulas for this part of the examination. Please use the attached sheets for your answers; any additional sheet will be discarded.
The questions serve as a leading trace for the oral examination, during which other aspects and details may be explored.

The questions concern the article: W. Henning et al., *Optical-model potential in single-nucleon-transfer reactions induced by heavy ions*, Phys. Rev. C 15 (1977) 292.
[Data for (bonus) calculations: $Z(\mathrm{N}) = 7$; $Z(\mathrm{O}) = 8$; $Z(\mathrm{Ca}) = 20$; $Z(\mathrm{Sc}) = 21$; for the interaction radius use $R = 1.55\,\mathrm{fm} \times (A_1^{1/3} + A_2^{1/3})$.]

Consider the figure below, where the data points are from the measurement and the continuous lines are from model calculations.



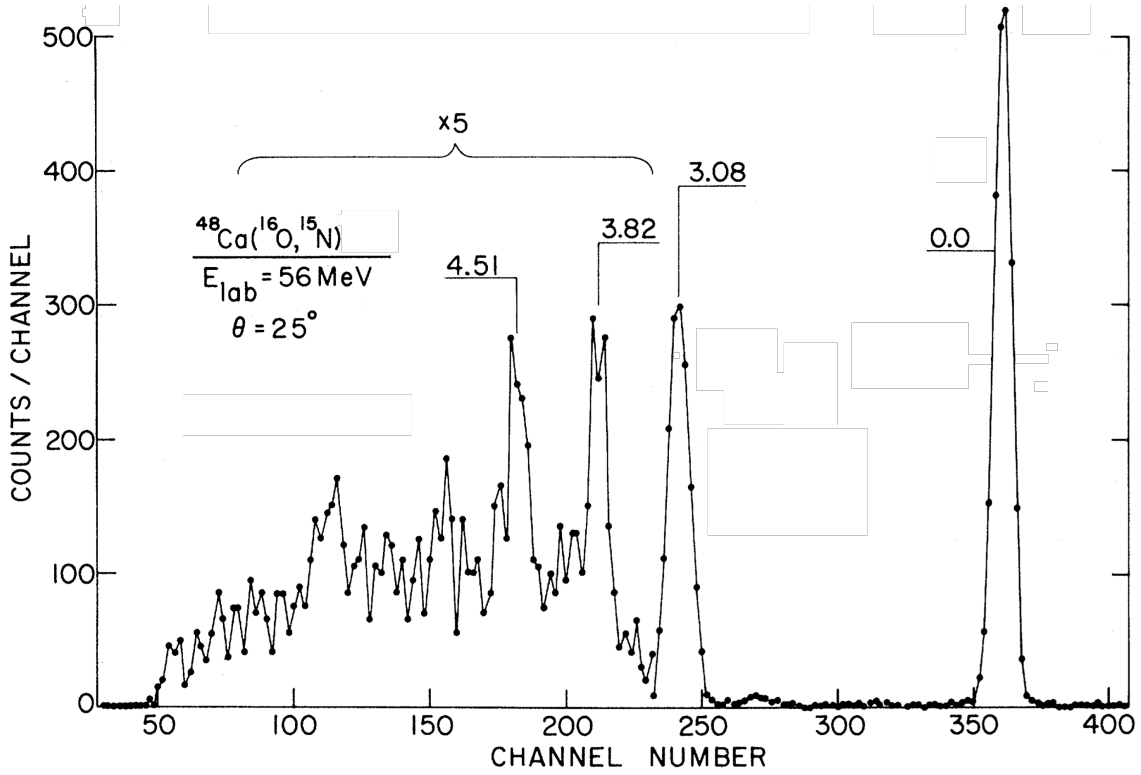
1. (4/20) Explain which kind of data are these (which reaction channel) and how they were obtained experimentally (details of the experimental arrangement). Indicate the quantity plotted on the y axis.

2. (5/20) Fully explain the behaviour of the data: the constant part, the oscillations, the decrease.

3. (3/20) Which model(s) can be used to describe the data (continuous line)? What can we expect to learn from the model(s)?

4. (1/20) Explain how you could add the expected values of $\theta_{\text{c.m.}}$ on the abscissa. (Bonus: 1/20, only if the rest of this question is answered correctly) Calculate the values and add them on the axis.

Consider now the second figure here below:



5. (1/20) Explain which kind of data are these and how they were obtained experimentally (what was detected, how is the histogram built).

6. (3/20) Why do we observe peaks? Which reaction mechanism produces them? What do the numbers on top of each peak most probably represent?

7. (3/20) Use the predicted sequence of shell model orbitals, given in the figure below, to deduce the expected spin-parity for the states corresponding to the two rightmost peaks. Indicate the expected transferred angular momentum l in the two cases.